

***OBJECTIVE DETERMINATION OF 3D CLOUD LOCATIONS USING SCANNING
MILLIMETER-WAVELENGTH RADARS***

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For presentation at
The Second Science Team Meeting of the
Atmospheric System Research (ASR) Program,
San Antonio, TX
March 28-April 1, 2011

**Environmental Sciences Department/Atmospheric Sciences Division
Brookhaven National Laboratory**

**U.S. Department of Energy
Office of Science**

ABSTRACT

The scanning ARM cloud radars (SACRs) are the primary instruments for the detection of cloud properties (boundaries, water content, particle size and habit, dynamics, etc.) beyond the soda-straw view. The first step before high-value-added products (VAP) can be developed using the multi-parametric radar measurements is the objective determination of 3D cloud locations (3D-ARSCL: Active Remote Sensing of 3D Clouds). The importance to the ARM data user community of determining cloud locations at the ARM sites is evident by the success of the 2D ARSCL VAP pioneered by Clothiaux et al. The development of the 2D ARSCL VAP required substantial resources and introduced the use of combined radar-lidar observations for the determination of the hydrometeor layer boundaries. Furthermore, the profiling ARM radars addressed the reduction of radar sensitivity with the square of the distance from the radar through the implementation of multiple operating modes that offer superior sensitivity at different parts of the atmospheric column. Thus, in the current ARSCL VAP, the height of the clouds above the ground is not a factor of concern. The transition from the profiling view to 3D contains several challenges that will be analyzed here. First, in 3D, the radar-lidar instrument synergy is not available and the determination of the cloud locations will be based on radar only. Second, due to fast scanning, the ability to operate modes with different sensitivity is limited, and we will have to address the reduction in sensitivity with range. Third, gridding of the quality-controlled radar data from spherical coordinates to a Cartesian grid is required. The coordinate system transformation is expected to ease the use of the scanning millimeter-wavelength radar data by the ARM user community. However, gridding cloud radar data is challenging especially if we consider the sparseness of radar observations with distance from the radar and the scales of clouds relevant to ASR scientific objectives. The aforementioned issues are discussed and potential solutions are presented in order to develop an objective methodology for the determination of 3D cloud locations.

NOTICE: This manuscript has been authored by employees of Brookhaven Science Associates, LLC under Contract No. DE-AC02-98CH10886 with the U.S. Department of Energy. The publisher by accepting the manuscript for publication acknowledges that the United States Government retains a non-exclusive, paid-up, irrevocable, world-wide license to publish or reproduce the published form of this manuscript, or allow others to do so, for United States Government purposes.